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ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 46.] OCTOBER. [1890.

CLXIX.—AN EDIBLE FUNGUS OF NEW ZEALAND.

(*Hirneola polytricha*, Montagne.)

For some years an edible fungus, a product of the New Zealand forests, has become an important article of commerce between that Colony and China. The fungus belongs to the same genus as the European Jew's-Ear (*Hirneola Auricula-judæ*), a tough but gelatinous fungus formerly in reputation as an ingredient in gargles. The New Zealand fungus now under notice (*Hirneola polytricha*) is well described by W. Colenso, Esq., F.R.S., in the Transactions of the Penzance Natural History and Antiquarian Society, 1884–85 :—

"*Hirneola polytricha* was first made known to science by Montagne as belonging to this genus, and as being an inhabitant of the East Indies and Java, though, like our two other species, it was first published as belonging to the closely allied genus *Exidia*, there being but a

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very small natural difference between these two genera. This species is thus briefly described by Berkeley (translated and abridged from Montagne) : 'Sub-hemispherical, cup-shaped, expanded, lobed, densely 'villous externally with grey hairs, disk purplish-brown.'

"It is of various sizes and, I might almost add, of shapes; some measuring a few inches, and when wet filling a large teacup or small basin; a large dry specimen weighing only 2½ drams. It is found growing on the trunks of many trees, both on living and on rotten ones (especially on the latter while standing), particularly on *Corynocarpus lævigata* and on *Melicytus ramiflorus*, both of these trees being endemic as to genus as well as to species; the former tree is mostly confined to the sea-shore, where it often forms dense and continuous thickets. In such situations it is generally of small size, but when standing apart it is of much larger dimensions, and not unfrequently in suitable spots it wears an imposing appearance from its large green and glossy persistent laurel-like leaves. The latter tree is scattered plentifully throughout the country, and the foliage of both being evergreen, are eagerly browsed on by cattle.

"The only market for this fungus is China. From official information obtained from Hong Kong, we find that it is largely used by the Chinese in soups with farinaceous seeds, and also as a medicine, being highly esteemed. The Chinese have long been in the habit of using another species of this same genus that is indigenous in North China, and also of importing another species from other isles in the Pacific; so that the use of this kind of fungus as an article of food is not new with them. Who can say in this article of food Western pride may not again have to learn something more from this ancient, highly-civilised, and much-injured people?

* * * * *

"At first, and for some time, our New Zealand fungus was only exported in small quantities. The demand, however, rapidly increasing, and the article plentiful and obtained at little cost, save the easy and untaught labour of gathering and drying it, its export rapidly increased. The drying of it, if collected damp, was an easy matter—merely spreading it in the air and sun till dry, which soon takes place, when it is roughly packed in sacks, and if kept dry keeps good and sound for a very long time. The price paid to the collectors for it was originally small, only 1*d.* a pound; at this figure it remained for some time. It is now nominally 2½*d.* in some places, which sum, however, is often paid in barter.* It is said to be sold in the China shops at about 10*d.* or more retail. I am not aware of the actual price obtained by the exporter, but we find that its *declared* value at the Customs has ranged from 33*l.* to nearly 53*l.* per ton, which no doubt is much under the real value.

"During the last 12 years no less than 1,858 tons of this fungus have been exported, valued at 79,752*l.*, as is more particularly shown in the

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* I should, however, mention that in the spring of 1883 a large party of Maoris residing on the West Coast, near Mount Egmont, who had for some time been collecting and storing fungus there, sold the lot to an Auckland agent and general dealer, but took the whole total sum, upwards of 425*l.*, in hard cash.

following return, which I have compiled from sources published in the Government statistical papers :—

Years.	Quantity.	Declared Value.
	Tons. cwt.	£
1872 - -	58 0	1,927
1873 - -	95 0	1,195
1874 - -	118 0	6,226
1875 - -	112 0	5,744
1876 - -	132 0	6,224
1877 - -	220 0	11,318
1878 - -	103 0	5,178
1879 - -	59 5	2,744
1880 - -	183 12	6,123
1881 - -	187 11	8,192
1882 - -	339 17	15,581
1883 - -	250 6	9,300
	1,858 11	79,752

"I should observe that the official entries show that those exports are confined to the northern island, and only from two ports there—viz., Auckland and Wellington—except some small lots amounting to 7 tons, exported from Poverty Bay and Napier in the last two years, 1882 and 1883. The fungus, however, may have been extensively collected in the districts containing those two larger ports."

In order to test the value of the New Zealand Fungus as an article of food a supply of it was recently obtained for Kew by Mr. Thomas Kirk, Chief Conservator of State Forests, Wellington, New Zealand.

A portion of this supply was submitted for analysis to Professor Church, F.R.S., who has been good enough to furnish the following interesting note :—

Hirneola polytricha.

A sample of this fungus, in the air-dried condition as received, was prepared for analysis by careful brushing and the removal of a few fragments of obviously foreign substances. It gave the following per-centages :—

Water - - - - - -	17·0
Albuminoids (calculated from total nitrogen) -	6·8
Carbohydrates, digestible - - - -	70·5
Carbohydrates, indigestible - - -	1·9
Fat (ether extract) - - - -	1·5
Ash - - - - - -	2·3

A few remarks as to these figures will prove useful in appreciating the food value of this fungus. First of all the nitrogen present does not all exist in the form of albuminoids. The coagulable albuminoids, as estimated by the phenol method, amount to 5·4 per cent.; the remainder of the nitrogen occurring chiefly as amides, is not nutritive. If this result be accepted, the proportion of albuminoids to digestible carbohydrates plus the starch—equivalent of the fat, becomes 1 : 13·7 instead of 1 : 10·9, as shown by the per-centages recorded above. Anyhow, this fungus is singularly poor in albuminoid or muscle-forming substances, and differs remarkably in this particular from the numerous

edible fungi of which analyses have been previously made. In these analyses we find at least twice or thrice as much albuminoid matters, often more.

The substance or group of substances which I have called "digestible carbohydrates" contains neither starch, nor inulin, nor cellulose. Its chief constituent is a gum-like body apparently allied to bassorin and well worthy of further examination. It swells up greatly in water and is soluble in dilute warm solutions of caustic alkalies. Its solutions gelatinize on cooling. I have observed what seems to be the same compound in other species of fungi, and it is probable that it has been described under several different names. The fungus now being discussed contains so large a proportion of this body that it presents a very convenient material for its isolation and the study of its composition and properties.

The ash of this fungus is rich in potash and phosphoric acid. Of the former constituent the ash contains no less than 42·02 per cent.; of the latter 20·02. These proportions are exceeded in the ash of other species; moreover, the amount of ash in one hundred parts of this *Hirneola* is much lower than that recorded for other fungi.

(Signed) A. H. Church.

CLXX.—MEXICAN FIBRE OR ISTLE.

The source of Mexican Fibre or Istle was discussed in the *Kew Bulletin* for December 1887, p. 5. This is a short and somewhat rigid fibre, used in the manufacture of cheap nail and scrubbing brushes. The fibre is prepared from one or more species of Agave, but, as stated in the *Bulletin*, it is probable that the plant known as Lechuguilla (*Agave heteracantha*, Zucc., Agave Lechuguilla, *Torrey*) yields the best qualities of Mexican Fibre or Istle used in the United States and in Europe.

We are indebted to Mr. W. S. Booth, Belle Vue House, Gloucester, for the following further account of this fibre, prepared from his own observations while travelling in Mexico, a few months ago:—

Mexican Fibre or Istle.

This fibre is classed in England not according to the plant from which it is extracted, but in reference solely to the district from which it is supposed to come. Thus Jaumave is understood to send long, clean, fine fibre, and gives its name to what is considered to be the best quality; Tula, a shorter and coarser fibre; and, lastly, Matamoras, a short and soft fibre, somewhat "woolly" and "off colour" (*i.e.*, brownish). Each of these three qualities varies considerably within its own limit.

Until lately little has been definitely known about the plants from which this fibre is extracted. According to the Kew authorities the fibre is yielded by *Agave heteracantha*, and closely allied species.

The fibre known in England as Jaumave is doubtless extracted from the Lechuguilla (*Agave heteracantha*). That known as Tula may be either from the Lechuguilla or the Palma loca (*Agave striata*), the inferior qualities coming from the latter plant. That known as Matamoras fibre may be either from the Palma loca or from various forms of the Espadillo, or again from varieties of Yucca, known to the natives as palma baréta or palma real. These palms and espadillos are often

picked and decorticated indiscriminately and mixed as they come to hand.

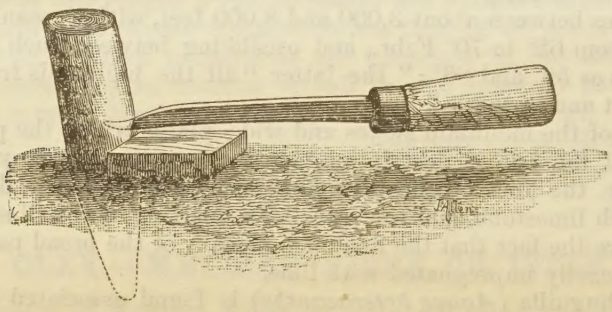
The various plants from which istle is extracted are found at present chiefly on the plains and rugged mountain slopes of the States of Coahuila, Tamaulipas, Nuevo Leon, and San Luis Potosi. The central towns for the trade in the several States are: Coahuila, Saltillo; Nuevo, Leon, Monterey; Tamaulipas, Jaumave, Tula, Tampico, and formerly Matamoras; for San Luis Potosi, San Luis Potosi.

The trade is carried on in these States owing to the exporting conveniences, but the plants exist all over the Republic. San Luis Potosi does by far the largest business in fibre, exporting by sea from Tampico, and also from the different points on the railroad *en route* to the United States. The heights at which these plants grow, lie approximately within the *tierras templadas* and the lower regions of the *terras frias;* the former comprising "all the higher terraces and the central plateaux "themselves between about 3,000 and 8,000 feet, with a mean tempera- "ture of from 62° to 70° Fahr., and oscillating between such moderate "extremes as 50° and 86°;" the latter "all the highlands from about "8,000 feet and upwards."

The soil of the mountain slopes and wide plains where the plants are found, is of the barest description, hardly covering in many cases on the hillsides the rocks beneath. Generally speaking it is a detritus of hard whitish limestone, and the traveller's smarting eyes will soon force on his notice the fact that the fine dust of many of the broad pan-shaped valleys is heavily impregnated with lime.

The Lechuguilla (*Agave heteracantha*) is found associated with five or six sorts of Cactus, Maquey (*Agave americana*), Huapilla, Zacate, Zamandogue, and palmas; forming a sparse vegetation about 6 feet high, with a long wiry grass so poor as to leave the grey dusty soil exposed underneath. Almost the only use to which this kind of land is put is that of corn raising and that only in small patches where irrigation is possible. The grazing of goats, sheep, cattle, and horses is also attempted, these endeavouring to glean a meagre subsistence from the Nopal (Cactus), scrub, and grass. On the rugged barren mountain sides and slopes of naked stones and boulders, the same plants are found only in a more stunted and dwarfed condition and yielding a shorter and coarser fibre. Nearly all the accessible country is owned by Haciendados, most of whom live in the towns, leaving their estates in the hands of an agent. With the exception of a few native Indian tribes who live in the more inaccessible parts of the mountains, the rural population is composed of christianised Indians and half-breeds, both called peons. These build round the hacienda their villages of mud, sticks and palm-leaf thatch hovels fenced in with cactus and maquey hedges and mud walls, and are quiet and docile, but lacking utterly any spark of intelligent ambition. The hands who are not regularly employed on the work of the hacienda wander out over the valleys and mountains with mules and donkeys to gather the raw leaves of fibre plants. The greatest quantity is gathered naturally at the end of the year when the harvest is taken in. The central mass of heart leaves (*cogolho*) in the plant is alone gathered, leaving the outside leaves (*penea*), or say about 70 per cent. to waste, as the flesh of these outer leaves is found to be too hard to work. Although a fresh crop of leaves springs up from the terminal bud which was previously protected, this process prevents the plant from flowering, thereby causing its decrease, as it dies after about four years of this treatment. Having got his load of cogolhos the peon makes his way back to the hacienda, where he sets about extracting the fibre,

for which when finished and dried he gets from 25 to 50 cents.* per arroba (25 pounds) either in money, or as is almost universal, in credit at the ranch store. The price he receives depends largely on the distance from which the cogolhos have been brought. Under the rude shade of palm leaf thatch or in the shade of the Mesquit trees the peons are to be seen preparing the fibre. With a bundle of raw Lechuguilla cogolhos at his left the man sits with his legs stretched out on either side of a wooden peg about 8 inches high and 3 inches in diameter driven firmly into the ground with a slant to the left. Fixed to this is another piece of wood about 3 inches square, about an inch above and parallel with the ground. About half an inch above this table the peg has a hole in it to receive the point of the *tallador*, a blunt-edged ironscraper in a wooden handle which the man takes in his right hand.



Tearing a cogolho to pieces, taking a leaf and dextrously stripping the thorny margin from its sides, he places a corn-cob in the hollow of the base end of the leaf to make a handle, then with the simultaneous action of both hands the point of the *tallador* is placed in the peg hole and pressed on the leaf half way from its point. The leaf is then pulled through, once for one side, once for another and a third time to give a finishing scrape. Then with a rapid motion the pulp is tapped from the *tallador* and the end of the prepared fibre is twisted round the cob (which the operator holds as if it were a spade handle), and the process is repeated for the other end (the base) of the leaf. When the pile of fibre has grown enough to warrant movement it is carefully spread out in the sun to dry. One cause of discolouration is a weak arm, which causes some of the pulp to remain on the fibre and give it a green tinge owing to lack of pressure; another is leaving it too long in the sun or air, which gives it a brownish tinge.

When a Lechuguilla has been once pulled it is called *lechuguilla capona*, and all succeeding growths of heart leaves will have withered burnt looking ends, owing to the delicate points of the young sprouting leaves being scorched by the sun. This accounts for the rusty ends seen on istle fibre in this country. After each pulling, too, the fibre of succeeding leaves naturally become more stunted and coarse.

The Haciendados generally bale the fibre in rough istle sacking in 200 lb. bales, and when sufficient quantity is on hand it is sent to the nearest central town or railroad depôt by trains of ox teams which carry about two tons apiece, or on mule trains which take a bale per pannier. These trains often travel 170 miles from point to point, and are frequently on the road from 15 to 20 days, allowing for breakages. Tula

* Mex. dollar worth 38½*d.*

and Jaumave are about this distance from Tampico, San Luis Potosi, or Vanegas. The roads are rough tracks along the bottoms of valleys and over mountain passes. In the valleys a team can be seen at a great distance by the cloud of white dust rising lazily around it. This dust is so fine and light that it hides the mules from the occupants of a buggy running before the wind. The mountain tracks are of the roughest description. They are full of boulders and deep hollows torn out by the mountain torrents, and broken waggons are as common a sight as vultures whirling over a dead mule.

The fibre from plants gathered in the mountains is, as a rule, coarser and shorter than that of those gathered in the valleys. The greater average length of the Jaumave istle is possibly accounted for by the lower altitude and greater fertility of the district. The quantity of fibre obtained from the Lechuguillas and Palmas is about 5 per cent. of the green leaves handled. Little, if any, fibre is lost in the manual process. The maquey leaves (*Agave americana*), owing to their huge size, go through a much more laborious process, and yield only from 2 to 3 per cent. of a long, wavy, fine fibre, used largely for twine, saddle pads, and fine matting. The cogolhos of the palma loca, palma baréta, and palma real go through exactly the same process as the Lechuguilla, with the exception that, having much harder flesh, they have to be *boiled* before the fibre can be drawn. This boiling or steaming, which goes on until the leaves are completely soft, turns the fibre a brownish colour, and at the same time makes it very soft by dissolving the stiffening gum in the flesh. Many men have invented machines which were to have revolutionised this hand process, but all, up till now, have failed—not in the quality of the fibre produced, for the results have been good in this respect—but in the cost of working. In the treeless deserts of Mexico there is no fuel and no water. Machines have hitherto required both; water, especially, for washing the fibre—an operation that is not required in the hand process. Also with the best machine there is more effort and system required, to say nothing of the services of an intelligent mechanic. A fortune is no doubt awaiting the man who can bring a machine to bear successfully on the millions of acres of closely growing agaves and yuccas of Mexico, whose fibres, besides their use in brush-making, mats, and sacking, are available also for paper when properly treated. Paper is already made from the maquey fibre in works outside Saltillo (Coahuila). The stems of the palmas, too, are a spongy mass of fibre ready for crushing and pulping.

The bulk of the fibre exported from Mexico now goes to the United States, where it is used for brush-making and for twine for reapers and binders. A failure in the harvest in America will, therefore, have an appreciable effect on its price. England and Germany take large quantities for brush-making, but our imports come largely through New York. Such things as trade statistics are difficult to obtain in Mexico. The only figures I have are unreliable. There are no export duties, but as a rule it costs about $20 (Mexican) for every shipment crossing the borders. This is made up of fees to Customs authorities on both sides, passing entries, and commission to agent undertaking to see it through. There is a tax of ½ per cent. on all transactions in the Republic, but many large firms contract themselves out of this tax, which is called Renta Interior, and is payable by the buyers. The present price of the finest Lechuguilla fibre (Jaumave) is from 30*l.* to 35*l.* per ton; that of shorter and coarser Lechuguilla (Tula), 28*l.* to 28*l.* 10*s.*; and of inferior Lechuguillas and Palma Matamoras), about 22*l.* per ton.

Before closing I may perhaps say that the Agave and Yucca fibre industry is at present in its infancy. If intelligently followed it might become a very prosperous enterprise in many of our tropical possessions where cheap labour and poor soils prevail. It might become still more prosperous by the use of economical machinery and intelligently managed plantations. In the *Kew Bulletin* for March and October 1889 the interesting accounts of the development of the fibre industry in the Bahamas will show what can be done by intelligent and systematic action.

I have to thank Mr. D. Morris, F.L.S., for the very kind assistance he has given me in tracing the correct botanical names of the plants here discussed.

(Signed) W. S. Booth.

CLXXI.—A FOREST PLAGUE IN BAVARIA.

(*Liparis Monacha.*)

A terrible pest to pine forests has made its appearance in Bavaria. It is there known as the "Nonnen," and is caused by the caterpillar of a moth (*Liparis Monacha*). It appears that these caterpillars have regularly attacked the forests on the Continent for the last 200 years or more. They have made their appearance after long intervals, but the destruction caused by them has been calamitous. In Bavaria alone it is estimated that the loss to the revenue for woods and forests next year will amount to about 40,000*l*. In some of the forests attacked by the "Nonnen" the excreta from the caterpillars has been noticed to lie six inches deep. The injuries committed by the caterpillars are often followed by those of bark beetles.

The following correspondence, forwarded to Kew by the Foreign Office, gives a detailed account of the attack on the Bavarian forests :—

Foreign Office to Royal Gardens, Kew.

Sir, Foreign Office, 21st August 1890.

I am directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before the Director of the Royal Gardens at Kew, the accompanying despatch and enclosures respecting the so-called "Nonnen" pest in Bavaria.

I am, &c.

The Assistant Director, (Signed) James Fergusson.
Royal Gardens, Kew.

[Enclosure.]

Mr. Drummond to Foreign Office.

My Lord, Munich, 18th August 1890.

A very serious pest of the insects known as *Liparis Monacha* or "Nuns" has lately been causing great destruction to the Pine and Fir Forests in certain districts of Bavaria. This serious calamity to the kingdom had its first germs two years ago, when the Government, according to a statement made by the Upper Bavarian Agricultural Association, took measures to prevent it spreading. On the other hand,

if public opinion is correct, the foresters, instead of carrying out hand and eye work in the forests, did not visit them as often as it was their duty to do. In any case the fact remains that the forest administration has been defeated by the "Nuns," and although everything is being done to extirpate them by killing thousands daily, it is now reckoned that nature alone, "winter frosts," can rid the forests of the pest.

It is calculated that the loss to the revenue from woods and forests for the next financial year will amount to 800,000 marks (40,000*l.*), and it is even feared that the amount may be larger, as where forests are injured by any special cause the "Bark beetle" follows and attacks the diseased wood, this will probably result next year.

The enclosed translations of extracts taken from the "Münchener Neueste Nachrichten" show the extent of the present calamity, and give a chronicle of the destruction caused by the "Nonne" and other insects since the year 1449.

Cuckoos, swallows, and other birds, as well as wasps and other insects, have assisted in getting rid of the "Nuns." Torches and bonfires have also been used with success. The electric light with a specially constructed exhauster has been used with some effect, the result being so far satisfactory that the majority of "Nuns" destroyed by this means were female.

I have the honour to enclose herewith copies of a pamphlet issued by the Bavarian Forest Administration, giving a full description of the *Liparis Monacha*, its habits, and the best means for its destruction.

I may mention that Munich has been invaded by the "Nonne" in immense numbers, and that in some places the people were obliged to retreat from them.

I have, &c.
(Signed) VICTOR DRUMMOND.

The Marquess of Salisbury, K.G.,
&c. &c. &c.

[Enclosure No. 1.]

NOTE from the Bavarian Forest Administration (Finance Department) on the "Nonne."

The Forest Department of the Ministry of Finance state that the "Nonne" plague is now extended over nearly all Bavaria south of the Danube in scattered tracts. The infested districts are estimated at about 10,000 hectares. The fertility of the insect is so great, and its numbers so enormous, that the Forest Department fear that no measures of destruction are of any avail. "We stand powerless before the immensity of the pest." The insect attacks chiefly the pine and fir with which Bavarian forests abound, but in default of these it does not despise the beech, oak, and other forest trees, and is even known to feed on shrubs and garden plants. It never attacks corn or wheat, and, curious to say, there is one tree it will not touch, viz., the horse chestnut.

The means of destruction are various. Forest bonfires of worthless wood form an easy means within reach of all communes, &c. The insects are attracted by the fire and are smothered in the smoke, but only a comparatively small number are killed. Children and boys are also sent out to destroy the insects. From September to April similarly the eggs can be found in the bark and destroyed, and in April the very young caterpillars can be more easily killed, all these however are mere partial measures. The only efficient general measure seems to be the

cutting down of whole forests when much infested, in which case the remedy is almost worse than the disease. One other method is used by the State, but not within reach of Communes, therefore not described in the official pamphlet. A large electric light is placed in the forest by night and attracts thousands and hundreds of thousands of "nonnen" to the mouth of a large funnel through which a rapid exhaust current of air is forced, sucking in the insects by thousands into a hole under the earth where they are buried. Even this is only a partial measure, for in a forest containing perhaps a hundred millions of "nonnen" it is not much to destroy 200,000 or 300,000.

The Forest Department consequently fear an even greater extension of the plague next year, and an even worse danger is threatened, viz., that of the "bark beetle," which, burrowing under the bark, is much more injurious to the wood and more difficult to kill. It is always found that where the forests are injured by any special cause the "bark beetle" follows and attacks the injured or diseased wood in vast numbers, and this is greatly feared will be the case in 1891. Great numbers of trees are being felled, but to avoid flooding the market with timber and causing a ruinous fall in prices, contracts and agreements have been entered into with neighbouring forest owners and the large timber dealers by which only certain quantities will be sold at a time, and prices will be maintained. The yearly "cut" in the *other* Bavarian forests has also been much reduced.

[Enclosure No. 2.]

TRANSLATION of an Article in the "Münchener Neueste Nachrichten" of August 10th, 1890, entitled "Chronicle of the Destruction of Forests through the 'Nonne' and other Wood Insects."

Just as men and beasts are from time to time carried off in multitudes by epidemics, which epidemics it has not yet been found possible entirely and finally to suppress by art and science and by doctors and veterinaries, in like manner the trees of the forest are now and then attacked and destroyed by forest insects. Fortunately these vanish as a rule as quickly as they come, by the operation of natural agencies. This is the only consolation we have in view of the desolate condition to which many of the pine forests of Germany, and in particular of Bavaria, have been reduced by the horrible devouring caterpillar the "Nonne."

Before now in earlier centuries our woods have been attacked by similar calamities, and yet the German forests grow green and thrive, and yield, year by year, higher rents. This may serve to calm too anxious minds and to correct the views of those who are so ready with their judgments, and who ascribe the blame of the misfortunes which have fallen on the forests solely to the forest officials.

However, the present "Nonnen" pest has nothing particular to do with the forest training nor the new forest organisation, nor with the style of forest husbandry in vogue, nor with the aims of modern woodcraft, for it is well known that destruction by insect plagues occurred hundreds of years ago, and therefore at a time when the trees grew of themselves in primæval fashion and there was no question of forest training nor of any particular forest husbandry. Besides this, the fact is not in dispute that the destructions caused by insects are much less intense in forests of mingled broad leaved and needle-leaved trees; but this money-loving world unfortunately insists on quick-growing pine forests instead of safe slow-growing woods.

1. In 1449 and 1450 a considerable plague of caterpillars attacked the Nürnberg forests, for which no remedy could be found. (*Nürnberg. Chronik.*)

2. In 1479, the May beetles, which had caused great destruction round Lausanne, were cited before the spiritual court, and an advocate from Freyburg granted them, and after mature consideration they were outlawed. (M. Stettler's *Schweizer Chronik*, p. 278.)

3. In 1502 so many caterpillars swarmed in Brandenburg that they not only destroyed the gardens but also ate the trees so bare that they stood up in the woods like broomsticks. (Angeli, *Annales March. Brand.* 1416–1596.)

4. In 1506 the Kurmark suffered a similar misfortune. (*Mannsfelder Chronik.*)

5. In 1719 the caterpillars ate up the tops of the fir trees near Freyburg in Saxony to such an extent that they withered up. At the same time all sorts of insects crept into the same places (probably bark beetles). (Von Karlowitz, *Answeisung zur Wildenbaumzuch.*)

6. In 1725, in the Anspach district, 1,000 acres of forest died away through the pine insect. (Kob. *Ursuche der Waldtrocknitz.*)

7. In 1726, near Nürnberg, 600 "morgens" of young wood were eaten up by caterpillars. (*Nürnberg. Chronik.*)

8. In 1729, in Thuringia, there were so many moths and butterflies that they almost flew into the mouths of the passers-by. (*Nürnberg. Chronik.*)

9. In 1734, in the Anspach and Nürnberg districts the pine insects caused great injury in the forests. (Meyer's *Zeitschrift für des Forst und Jagd wesen.*)

10. In 1737 the caterpillars made such a dreadful invasion into the Thuringian Forest, that in a small part of the Duchy of Meiningen in 1742, 2,985 cords of dead wood still lay on the forest; but by good fortune at this time glass furnaces were introduced, which absorbed the wood killed by the "nonnen" pest. (K. v. Sprengeisen, *Topograph.* etc.)

11. In 1776 the caterpillars devoured great districts in the Ukraine, where they had been quite unknown for 40 years. (Hennert.)

12. In 1783 and 1784, in the Fichtelgebirge (Bayreuth district), the "nonnen" caterpillar caused great damage to the old and young pine trees. The bark beetle followed and finished the trees. (Kob.)

At the same time the "nonne" and other insects were busy in the Vorpommersche Forest.

In 1783–86 the bark beetle caused immense devastations in the Harz and other German districts, and in the Harz this continued until the end of the century.

13. In 1783–88 and 1790–93 the great pine caterpillar caused great damage in the district of Soran, often a single branch bore a whole "schock" of caterpillars.

In the Görlitz Heath also the caterpillar plague was very considerable, and more than 18,000 cords of wood were consumed for fuel.

14. In 1791–96, in the forests of Kurmark, although for five years no trace of the caterpillar had been found, 650,000 "morgens" of pine forest were devoured by the great pine caterpillar and the seventh part totally destroyed. (Hennert.) The bark beetle also took part in this destruction. The pest also spread to Mecklenburg, Saxony, and Bohemia.

15. In 1795–96 several thousand "morgens" of fir woods were destroyed in Prussian Lithuania and West Prussia. (Hennert.)

16. In 1796, near Amberg, in the Oberpfalz, the pine woods were so attacked by the pine spider, that some 100,000 cords of wood were killed. (V. Linker.)

17. In 1794–97 the "nonnen" caterpillar appeared in Vogtland, viz.:—in the pine and fir forests of Lobenstein, Schleiz, Ebersdorf, and Saalburg, and worked vast destruction, so that the loss was reckoned at 2,000,000 cords of wood, and the plague also threatened the neighbouring forests of Altenburg, Electoral Saxony, Saalfeld, and Schwarzburg.

Bechstein, in his Forest Insectology (1818), describes the great destruction caused by the "nonnen" caterpillar in 1794–97 in Vogtland, Lithuania, and West Russia, and gives figures which correspond exactly with our present situation. Seventy-two years ago he wrote as follows:—

"It is horrible to travel in those districts where these caterpillars swarm. Many thousands crawl up and down the trees. One cannot take a step without treading on a number of them. There is a perpetual rain of their excreta, which often lies six inches deep, and being dissolved by the rain, collects in puddles, which diffuse a pestilential stench. One can form no idea of the magnitude and terrible nature of the destruction. Fortunately Nature herself stopped the pest through a kind of dysentery which attacked the caterpillars in the beginning of June 1797. This deadly sickness was attributed to a kind of mildew. The caterpillars collected together in great thick clumps, four to six inches across, the excreta became pale, the intestines dirty, and so they died, leaving behind them a disgusting stench."

As to the measures of prevention and suppression of that day, they hardly differed from those in use now. Bechstein, in 1818, recommended, 1st. protection and encouragement of insectivorous birds; 2nd. protection of useful insects which attack and pursue the "nonnen"; 3rd. scraping the eggs off the trees with brooms and scrapers with long and short stems; 4th. picking off the moths, caterpillars, and cocoons (in 1796 the Prussian district administration at Hof caused 1,838,000 female butterflies to be caught, and paid 6 kreuzers for every thousand); 5th. the lighting of a number of small bonfires on dark nights (for it is well known that butterflies are attracted by the moonlight), and they paid in Bayreuth in 1796 for one night's maintenance of fire and bringing wood 5 groschen; 6th. isolation of the districts attacked by broad paths and ditches; 7th. cutting off in March and April of the branches nearly to the vertical, and burning them; 8th. cutting down of whole standing trees, and burning of the branches and bark; 9th. removal of moss and litter from the forests and burning, if eggs or caterpillars are found therein.

18. In connexion with the injury caused by the "nonnen" in this century, we may briefly mention here the extensive "nonnen" plague of 1839–40 in Upper Suabia (Würtemberg), which ravaged many hundreds of "morgens" of pine forest. The same thing was repeated in 1855, and at the present moment is appearing almost in the same spots in a very serious manner. But the most considerable "nonnen" pest of all took place in Russia, and spread from 1845–1868 in a most devastating manner over Poland, Lithuania, and East Prussia. The invasion in East Prussia began suddenly in 1853, in the night of July 29–30, and covered a superficies of about 60 German square miles in the administration of Gumbinnen, after it had already crossed over

in 1851 and 1852 the southern boundary of the administration of Königsberg. At that time the "nonnen" moths were driven by a storm into the sea while on their way, so that the insects were thrown up by the waves on to the coasts for a distance of 10 German miles in a bank 7 feet wide and 6 inches thick, and were used as manure by the coast inhabitants. The extent of the ravages in Russia at that time was 6,400 German geographical square miles, in East Prussia 600 ditto, total 7,000. At the very least 55,000,000 Prussian cords of wood, or 184,000,000 cubic metres of wood, became the prey of "nonnen" and bark beetles.

These few examples may suffice to show that the "nonnen" have made their appearance in former centuries in large numbers, and have generally disappeared with equal suddenness. The present catastrophe will likewise come to an end, after causing heavy losses, though it may possibly return many years later. But we possess no radical remedy against the "nonnen," and it seems doubtful if we shall ever find one. At all events it is the duty of the forest managers, forest owners, the Government, and the whole population to come to close quarters in every possible way with this dangerous visitor, even although Nature herself up till now has proved herself the best helper, and may continue so in future. When, however, the present evil will be conquered that God alone can certainly tell. Let us hope for the best.

CLXXII.—OKRO FIBRE.

(*Hibiscus esculentus*, L.)

The plant variously known as okro, okra, gobbo, gombo, and quimbombo, is widely cultivated in the tropics for its horn-like pods, or seed vessels, which are used as a table vegetable. They are exceedingly mucilaginous, and are made into soups and sauces. The ripe seeds are sometimes parched and used as a substitute for coffee. The plant is an annual herb, with a stout hairy stem from 2 to 5 feet in height. The leaves are large, three- to five-lobed, coarsely toothed, with petioles about 6 inches in length, more or less bristly. The flowers are yellow, with a brown or crimson centre. The fruit is pyramidal-oblong, 6 to 10 inches long, and about ½ to 1 inch in diameter, with five prominent ribs and smooth. The spherical seeds are grey or greenish, obovate, and covered with fine hairs.

The Okro (*Hibiscus esculentus*, L.), Abelmoschus esculentus, W. & A., is probably a native of India, but it is now naturalised or cultivated in all tropical countries. Vilmorin distinguishes two varieties in cultivation: the long-fruited green okro, and the round-fruited okro. In the latter the fruits are short and comparatively thick, being about 2 inches long and nearly 2 inches in diameter, and blunt at the ends rather than pointed. There is said to be a sub-variety of the long-fruited green okro with pendulous pods.

The okro has long been known in India and elsewhere to yield a long silky fibre, the breaking strain of which, according to Roxburgh, is 79 pounds dry, and 95 pounds wet. Specimens of Indian ochro fibre in the Kew Museums resemble hemp in colour and texture. It is evidently well adapted for making ropes, twine, and sacking, while the residual portions could be utilised for paper-making.

Recently the preparation and use of ochro fibre has been revived in both the Southern United States, where the plant is largely grown during the summer months, and also in Cuba. In the Report of Mr. Consul Ramsden on the Trade, Commerce, and Agriculture of the Province of St. Iago de Cuba for the year 1889 [F. O. Annual Series, No. 779], the following information is furnished respecting the fibre of the okro plant, known in Cuba as the quimbombo :—

"The fruit of the quimbombo (*Hibiscus esculentus*) is well known in the English West Indies under the name of 'okra,' and is used as a vegetable, but although Pichardo, in his 'Diccionario de Voces Cubanas,' mentions the plant as being 'applicable to rope making,' I am unaware that it has been used as a fibre, and, therefore, refer to it here. Last year Messrs. Bosch and Company, of this city, made an experiment with some, and sent 400 pounds of the dried fibre to London, where they say it was much liked, and found to be worth 40*l.* per ton. Three crops are obtained in the year, and its preparation by maceration gave very little trouble. The stem produces a fibre of fine quality, and about 4 feet in length, and apparently strong. Further trials will probably be made here. I send a sample of it with this report."

The sample of fibre above mentioned has been forwarded to Kew by the Foreign Office, and is now in the Museum of Economic Botany.

With regard to the commercial value of this Cuban fibre, Messrs. Ide and Christie, of 72, Mark Lane, E.C., to whom it was referred, report as follows :—

"*Hibiscus esculentus.* The sample shows the fibre to be only moderately stronger than Jute, imperfectly cleaned, and very yellow in colour. We value it at 18*l.* to 20*l.* per ton to-day in London. It is possible that the colour could be greatly improved by more careful preparation and that in that case its value might be increased by 4*l.* or 5*l.* per ton.

"We cannot imagine it possible that fibre of this type could have been found worth 40*l.* per ton last year in London as stated to the Consul and mentioned in his Report."

CLXXIII.—COCOA-NUT BUTTER.

(*Cocos nucifera, L.*)

A valuable edible fat prepared from the kernel of the cocoa-nut has lately come into commerce on the Continent under the name of cocoa-nut butter. It appears that the method of preparing this cocoa-nut butter is the invention of Dr. Schlinck. The butter is a white, inodourless and almost tasteless fat, which solidifies at about 65° Fah.; above that temperature it becomes a pure white oil. Its low melting-point is against its general use as a butter in warm countries, but in other respects it may be well adapted for culinary purposes.

If this cocoa-nut butter can be prepared, as is suggested, from the ordinary "copra" or dried kernel of the cocoa-nut as shipped from tropical countries, there would be an almost unlimited supply of the raw material available from various parts of the world.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
SIR, 9 June 1890.

I HAVE the honour to inform you that I learn from the commercial journals that a new and important industry has sprung up in Germany. It is stated that "about two years ago a German chemist, "Dr. Schlinck, discovered that excellent butter could be made from "cocoa-nut milk . . . . The cocoa-nuts required are imported from "India, chiefly Bombay, in large and increasing numbers, and the trade "seems likely to attain still greater importance."

2. Numerous inquiries have been addressed to this establishment on the subject. The published statements are not, however, altogether intelligible to me. I venture to hope, therefore, that the Secretary of State may be disposed to instruct H.M.'s Commercial Attaché for Europe to make inquiries into the matter for the purpose of acquiring all available information as to the nature of the manufacture, the place where it is carried on, the amount of the out-turn, and the markets in which it is disposed of.

3. I should propose on the receipt of this information, with the approval of the Secretary of State, to publish it in the *Kew Bulletin* for general information.

I am, &c.
(Signed) W. T. THISELTON DYER.

Sir Villiers Lister, K.C.M.G.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, 14 July 1890.

WITH reference to your letter of the 9th ultimo, I am directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before the Director of the Royal Gardens, the accompanying Report by the British Vice-Consul at Berlin on butter made from cocoa-nut milk.

I am, &c.
(Signed) JAMES FERGUSSON.

The Assistant Director,
Royal Gardens, Kew.

BRITISH VICE-CONSUL at BERLIN to His Excellency Sir E. B. MALET, G.C.B.

YOUR EXCELLENCY, Berlin, 9 July 1890.

I HAVE the honour to acknowledge the receipt of your despatch of the 14th ultimo, and beg to lay before you the information I have obtained on the subject of cocoa-nut milk butter.

The process of producing an edible fat from the "marrow" of the cocoa-nut (cocoa-nut butter) is about five years old, and has been developed by Dr. Schlinck at Ludwigshafen on the Rhine, having been

carried out as a manufacture since the beginning of 1888 by Messrs. P. Müller and Sons at Mannheim, Baden.

This process has been patented in most civilised countries.

As to the actual manufacture of the article I regret to state that I could not get any details, as it is patented. Messrs. P. Müller & Sons are at present the only manufacturers on the European Continent, but I am told that the following manufactories are about to be established: Paris, *Société industrielle des nuites de palme;* Amsterdam, *Nederlandsche Plantenboter Matschapy.* The proprietors of both of these establishments have purchased the patent; the technical management is under the direction of Dr. Schlinck, and both will shortly commence working.

The article has at present an unlimited sale. Messrs. P. Müller & Sons trade principally with Germany and Switzerland. Statistics with reference to the returns are kept by Messrs. Müller for their private use, but they are said to be steadily on the increase, and have doubled since the commencement of the business. Occasionally the demand has been much greater than the supply (50 cwts. per day are manufactured at present), but a proposed enlargement of their factory will enable them to increase this production.

According to a concession granted by the Prussian Minister of the Interior the cocoa-nut butter manufactured by Messrs. Müller & Sons has been admitted into the Royal Institutions to be used for culinary purposes. It is possible that this concession may influence the market in other directions.

My informant has used this butter in his household for some time, and is perfectly satisfied with it.

I enclose some printed matter which may give more detailed information on the subject.

I have, &c.

(Signed) H. von Bleichröder
(British Vice-Consul).

H. E. Sir E. B. Malet, G.C.B., &c.

[Enclosure I.]

Translated from the "Centralblatt für die gesammte Terapie" for October 1889. From the medical department of Professor Drasche in the Royal Imperial and General Hospital at Vienna.

Cocoa-Butter.—A new edible fat. By Dr. Th. Zerner, Junior, Second Physician of the above department.

Cocoa-nut kernels are exported under the name of copperah or copra. Such a cheap and abundant material has received numerous applications. The attempts made within the last few years to produce from the cocoa-nut a substitute for animal fats (lard and butter), which should be both cheaper and wholesome, are of great interest. Such an attempt appears to be worth the trouble, on account of the importance of fat as a food, particularly for soldiers, prisoners, and the poorer population, who can scarcely pay the price of butter, and who can never be satisfied with the substitutes which are certainly not innocent of the frequent, and not always harmless, production of disorders of the stomach and bowels. On the other hand, the physician would greet with pleasure any success that would place at his disposal a fat which could be eaten by persons

troubled with imperfect digestion. These conditions have not been met by the preparations of cocoa-nut butter recommended up to the present time. They were all easily melted, and on account of the great quantity of free fatty acid which they contained were unfavourable to digestion. At present, however, P. Müller & Son, of Mannheim, have for a year past produced a cocoa-nut butter which is free from fatty acids. This fat is also obtained from the copra, which is taken out of the shell, dried in the sun, and pressed. The further preparation takes place in Europe according to the method of Dr. Schlinck, of Ludwigshafen on the Rhine. Supposing the accounts to be correct, we have a food possessing great economic and dietetic importance, and therefore worth a careful trial from the points of view before mentioned.

The cocoa-nut butter, which, on account of its low melting-point, is exported in tins, furnishes a pure white transparent mass of the consistence of lard without granular texture, which at a temperature of 79° F. melts to a clear fluid and solidifies again at 67° F. It has a slight agreeable smell, melts on the tongue, leaving a mild but in no respect acrid taste behind it. In ether it dissolves completely. If the ether is evaporated over water and distilled water is added to the residue, the solution gives a neutral reaction. I have often repeated this test with cocoa-nut butter, which had remained open for days (14 days), also with pharmaceutic preparations 8 to 14 days old, in the preparation of which cocoa-nut butter had been used. The cocoa-nut butter is therefore free from fatty acids, and even if left open for the space of 8 to 14 days, does not turn rancid, with the exception of the top layer which comes in contact with the air.

With regard to its chemical composition, cocoa-nut butter differs from most other fats, and particularly butter, lard and margarin. In its fatty constituents and the amount of volatile fatty acids, it stands next to butter among solid fats. The determination undertaken by Fresenius of the per-centages in the composition of the fat gave the following result:—

100 parts cocoa-nut butter gave—

Fat	99·979
Water	0·020
Ash	0·001
	100·000

A very similar result was obtained by Rupp in Karlsruhe—

Water	0·0008
Ash	0·0060
Fat	99·9932
	100·0000

If we compare the composition of milk and margarin butter we have in 100 parts of milk butter—

Fat	84·90
Ash	·16
Casein	·72
Water	14·22

100 parts margarin butter—

Fat	82·90
Casein	·57
Ash	1·03
Water	15·50

Cocoa-nut butter differs from all other vegetable and animal fats by its saponification degree (258·5 according to Rud. Benedikt in Vienna). On account of this high saponification degree all adulteration is impossible.

Artificial digestion tests were made according to the directions of Dr. Katz, which are the safest and the least objectionable. An artificial digestion fluid (0·2 pepsin in 100 parts of 2% solution of hydrochloric acid) with given quantities of an albumen solution of known concentration and of the fluid cocoa-nut butter were subjected to a temperature of 102° F. A control mixture showed the strength of the digestion fluid used. After four hours the nitrogen was determined and the quantity of peptone calculated. As an average of the experiments made the result of the control solution was a yield of 0·0912 peptone, while that in cocoa-nut butter showed an average of 0·0880. This small difference will possibly admit of the conclusion that the cocoa-nut butter exercises no injurious influence whatever over digestion.

The next point was to ascertain how the cocoa-nut butter stands with regard to micro-organisms. It is well known that in this respect milk butter is very far from perfect, as apart from the numerous germs, which, for the most part, are not pathogenic, that may be introduced during its preparation, and the microbes already present in the milk itself, this article of food affords an excellent nutrient fluid for a large number of micro-organisms.

It follows that although in any given case other ways and means of infection may be excluded, this may still take place through the agency of milk and butter. The possibility of a transfer to the human consumer of the Tubercle bacillus, as well as of other micro-organisms, which have got into the milk from animals suffering from infectious diseases, it is in the case of cocoa-nut butter, a vegetable fat, excluded from the first. Cocoa-nut butter has been proved by our investigations to be both free from germs and also to be a very bad nutrient medium for micro-organisms. Even when Agar-Agar [or Ceylon moss, *Gracilaria lichenoides*] was mixed with the cocoa-nut butter, and then allowed to remain open, the number of germs was found to be less than in Agar-Agar without the mixture of butter. One more experiment may be mentioned. If sterilised milk is added to cow butter and kept at a warm temperature, the milk coagulates in 24 hours, proving the presence of bacteria in the butter. This coagulation does not take place, if, instead of milk butter, cocoa-nut butter is added to the milk.

From what has already been said the conclusion may safely be drawn, that the cocoa-nut butter, from a chemical and bacteriological point of view, meets all the requirements of a food substance.

Our further investigations were directed to ascertaining whether cocoa-nut butter was also suitable to healthy and sick people alike. Through a period of four weeks we distributed food to 116 patients in the form of pastry, roast meats, and farinaceous foods, in the preparation of which cocoa-nut butter was used in the place of fats.

On account of this fat being almost free from water, one quarter less may be taken, both in baking and cooking, than is generally used, if ordinary butter or lard is employed; and for the same reason it is necessary in making pastry to replace the 25 per cent. of water, which the cocoa-nut butter contains less than any other fat, by adding from seven to eight tablespoonfuls to about every pound of butter used.

A little more salt must be added to the food, and the butter must always be heated before being used for cooking. Food prepared in this way, as well as pastry, were always found to be eaten without any inconvenience whatever. The taste was undoubtedly pleasanter than in dishes prepared with animal fats. The statement of a colleague, Dr. H., is of particular importance in this respect; after recovering from disorder of the stomach he could not eat pastry without being afterwards troubled with pyrosis, and cardiac pain. He could eat pastry prepared with cocoa-nut butter, almost without any inconvenience.

The experiments with patients proved cocoa-nut butter to be an easily digested fat that causes no disorders in cases of impaired digestion. Of the 116 patients, amongst whom were individuals affected with every form of dyspepsia, not one complained of any discomfort, or of any ill effect after the consumption of pastry prepared with cocoa-nut butter, though pastry, as a rule, is not an easily digested food on account of the fat. In three cases where the pastry was partaken an hour after vomiting, there were no ill results noticeable; on the contrary a fresh supply was desired by the patients.

We arrive at the conclusion that a fat has been found in cocoa-nut butter, which meets all hygienic requirements, and which is far superior to animal fat and butter, as well as to any of their other substitutes. Further, on account of its being easily digested, cocoa-nut butter is particularly well adapted for the use of patients suffering from impaired digestion.

[Enclosure 2.]

A pamphlet entitled "Mannheimer Cocosnuss-Butter-Fabrik," issued by P. Müller und Söhne, contains the following analyses of cocoa-butter:—

Professor Guignet, Deputy for M. Chevreul at the Museum, Paris.

Analysis of a sample of vegetable butter (cocoa-nut).

A white fat without taste or smell. It melts towards 80° F. into a colourless transparent liquid which solidifies again a little above 68° F.

It dissolves entirely in carbon bisulphide without appreciable residue.

When saponified it forms a limpid solution with water which proves its freedom from admixture with mineral oil.

100 parts contain,—

Ordinary neutral fatty bodies - - -	97·50
Butyrine, the neutral fatty body which exists in butter - - - - - -	1·42
Water and loss - - - - -	1·08
	100·00

These proportions are those of pure cocoa-nut butter.

Paris, July 22, 1888.

(Signed) Guignet,
Chargé du Cours de M. Chevreul au Museum.

M. E. Durain, chemist, Vice-President of the Association of Chemists.

Paris, July 13, 1888.

Water - - - -	·16
Fatty matters - - - -	99·71
Ash - - - - -	·01
Volatile acids - - -	·00
Unaccounted for - - -	·12
	100·00

The following additional information respecting cocoa-nut butter is given in a Report by the United States Consul (Mr. Monaghan) of Mannheim [U.S. Consular Reports, No. 108, September 1889, p. 133]:—

German chemists discovered in the cocoanut a fatty substitute for butter. This discovery was made by a Dr. Schlink, practical chemist at Ludwigshafen, just over the Rhine from Mannheim. Shortly after the discovery was made, a firm was established in this city under the name of "P. Müller und Söhne," which sunk a large amount of capital in an enterprise having for its object the production of the new article, to which they have given the name of cocoanut butter. The results achieved have more than justified their expectations. The firm is not able to answer its constant demands. Although in existence only one year, it employs 25 workmen, who get from 25 to 75 cents a day, has a 40-horse power engine, and produces daily 3,000 kilograms of butter, which retails at from 55 to 65 pfennigs, or from 13 to 15½ cents per pound, or 25 to 30 cents per kilogram.

The nuts are obtained from almost all lands lying in the tropics, especially from the South Sea and Coral Islands, Arabia, the coast countries of Africa, and South America. Natives in countries where the nuts grow have for a long time used the milk of these nuts, instead of food oils.

It contains 60 to 70 per cent. of fat, and 23 to 25 per cent. of organic substance, of which 9 to 10 per cent. is of albumen. Liebig and Fresenius had already discovered the value of the cocoanut oil, or fat, but did not succeed in its production as a substitute for butter. The new butter is of a clear, whitish colour, melts at from 26° to 28° Celsius, and contains

Water - - -	0·0008
Mineral stuffs - -	0·0060
Fat - - -	99·9932
	100·0000

It hardens at 66° F. It is better adapted, however, for the kitchen than for the dining-room, that is, for cooking purposes than for the uses to which butter is put on our tables. It is neither disagreeable to the taste nor smell. In a country where real butter runs all the way from 25 to 35 cents per pound, and cocoanut butter costs but 15 cents, a great future must open up before the latter. At present it is chiefly used in hospitals and other State institutions, but is also rapidly finding its way into houses or homes where people are too poor to buy butter. The working classes are rapidly taking to it, instead of the oleomargarines, against which so much has been said in the papers during the last two or three years.

The new butter is said to be singularly free from acids and other disturbing elements so often found in butter, especially that made from milk taken from cows diseased with tuberculosis. Here it is estimated that fully 10 per cent. of the milk-giving cows are so troubled. This absence of acids and other matter renders its digestion much easier, hence the preference already shown for the new article by hospitals and such institutions. There are those who do not hesitate to declare this new substitute as healthier and infinitely preferable to the too often bad butter brought on the markets, and not to be named in the same breath with the oleomargarines made too often from the diseased fat of horse and sheep flesh.

When it is remembered that Germany has already some fifty factories making oleomargarines and other artificial butters, and that some 180,000 centners are produced annually, it will be readily seen that regular butter will have hard work to hold its own in a hundred uses against its new rivals, and especially so since the oleomargarines and artificial butters of all kinds are placed under severe, careful, and watchful State inspectors. It is hoped, however, that no losses, but gains rather, will arise ; for, besides the profits resulting from the new substitutes, more meat and milk, as such, will come on the markets, and consequently into use.

Now, if these facts are once known, milk, as an article of diet, will be more in demand, and the quantities no longer needed to make butter will find their way into the families where formerly pure butter was unknown, but where its substitute, cocoanut butter, has taken fast hold.

The principal purpose of this report is to call attention to this new article with a view to intercepting its introduction from abroad as an article of import. If it is what chemists and hospital supervisors say it is, its manufacture in the United States, where such vast quantities of butter are consumed, should be undertaken.

(Signed) J. C. Monaghan,
Consul.

United States Consulate,
Mannheim, August 6, 1889.

The preparation of butter from the fresh cocoa-nut is thus described in the *Proceedings* of the Agricultural and Horticultural Society of India, for June, 1890 :—

In answer to an inquiry the following reply was sent on the subject of making butter from cocoanuts :—" My experiments were on a very small " scale. The cocoanuts were scraped out with a *Karni* in the usual " way, a small quantity of water added and rubbed in a mortar. The " milk-like fluid was then strained through cloth and churned in a " bottle. The churn used was a disc of wood of about the same diameter " as the bottle, cut with a wavy edge and with holes through it, this was " forced up and down by means of an upright handle. The churning " was over very quickly and the fat globules on being formed were " skimmed off and washed in salt and water. The kernel which had " been strained off was put into a small cheese press, and the fluid " squeezed out added to the 'butter-milk' and again churned, a further " small quantity of butter being obtained. The cake of scrapings still " retained its flavour and would be fit for various purposes.

" The butter was almost tasteless while fresh, but after being kept a " day (in the cold weather) had a strong taste of cocoanut. It had the " appearance and consistency of butter but was very white." The

writer continued by stating that the authorities at Kew had been asked by the Society if they could afford information as to the manner in which cocoanut butter is deodorised in Germany, but they had stated that the subject had not come before them, and suggested that the information might be obtained through the Government of India; the subject being of considerable interest to India.

Mr. B. C. Basu, of the Agricultural Department of Bengal, very kindly communicated the results of his experiments in the following letter:—

"I took four nuts of average size, neither very big nor very small, and had the kernel reduced to a coarse pulp with a native instrument called *Karni*. The nuts were not fully ripe; the kernel was fully formed, but was yet a little soft. After the kernel had been made into pulp, the latter was squeezed in a thick piece of cloth to express the 'milk.' A little water had to be added to the pulp to make the milk run out freely. The whole of the milk could not, however, be expressed, as I had no proper appliances to do the work. The 'milk' was measured and found to be 3 paos or roughly 24 ozs., of which quantity 1 pao may be taken as water added to the pulp in the act of expressing the milk.

"Immediately after the milk had been expressed, it was churned in a soda-water bottle. I intended to use the English churn which I have recently procured from England, but the quantity of milk was too small to be put into a churn. I should mention here, that in the experiment with cocoanut milk which I made in the last cold weather, I had no need to add any ice or cold water, but in the present experiment which was made sometime about the end of last April, the weather was hot, the consequence being that the butter refused to 'come.' I then added a little iced water to the 'milk' in the soda-water bottle, and the butter grains immediately appeared. The whole operation did not take more than 15 minutes, and could be finished in half the time if cold water was added in the beginning. All that I had now to do was to wash the butter in cold water, and gather it into a lump. The butter weighed just a little over $1\frac{1}{2}$ chittaks or 3 ozs., that is, $12\frac{1}{2}$ per cent. on the milk. This I considered encouraging; but my surprise and disappointment were great when on opening the vessel in which I had put the butter, I found that it had all melted and was floating on the top of the water. In the cold weather the butter kept pretty firm day and night; but in the hot weather it would be impossible to keep it solid, unless it was put in iced water. Under the circumstances, I believe it is useless trying to make cocoanut butter in a hot climate like ours."

CLXXIV.—SOIL AND CULTIVATION IN YORUBA-LAND.

Yoruba-land forms a part of the native territory adjacent to the Colony of Lagos, West Africa.

The following interesting account of the soil and cultivation in this part of the world has been prepared by Mr. Alvan Millson, Assistant Colonial-Secretary of Lagos, and lately a Special Commissioner to the interior. The observations made by Mr. Millson with regard to the operation of earthworms in cultivating and improving the soil are worthy of special

notice. It may be mentioned that the specimens of earthworms received in this country have been submitted to Mr. F. E. Beddard, F.Z.S., Prosector to the Zoological Society, who reports that they belong to a probably new species of the genus *Siphonogaster*. The type of this genus has been quite lately described from the Nile mud.* Any further results that may be obtained with regard to the worms or the chemical composition of the soil will be dealt with later. It may, however, be mentioned that the action of the worms on the soil is probably of a purely mechanical nature. They, in fact, work the soil and expose it to the light and air, and thus render it capable, with little further preparation, for the production of recurring crops of yams, corn, cotton, and tobacco.

Sir Alfred Moloney to Colonial Office.

Government House, Lagos,
June 11, 1890.

My Lord,

In connexion with his recent visit to the interior I have the honour to transmit copy of a paper by Mr. Alvan Millson on the soil and cultivation of Yorubaland, with special remarks on the work of earthworms.

2. I also forward, addressed to the Under Secretary of State to the care of the Crown Agents, a box containing six specimens collected and referred to by Mr. Millson.

3. Mr. Millson suggests that the specimens of soil should be analysed by an expert in England, and that the earthworms should be examined by a competent authority with a view to determining their species.

4. I venture to support Mr. Millson's suggestions, and would ask your Lordship to be good enough to allow the analysis and examination to be carried out.

5. Should your Lordship approve of such investigations, I would further ask, in the interests of science and as a contribution to our knowledge of the resources of the interior, that Mr. Millson's paper and the reports of the experts upon the specimens may be printed.

6. By way of comparative interest I also send forward specimens of earthworms and of their castings I have myself collected at Joffin, on the west side of the kingdom of Pokrah, a distance of some 195 miles from the site of Mr. Millson's observations, where, from their habits, as personally observed, I can endorse Mr. Millson's remarks on the wonderful activity and utility of this West African silent fertiliser.

7. It will be interesting to know whether the creatures are the same species; their castings seem to point to a richer soil in Pokrah than at Ikirun.

8. The Yoruba name for earthworm is *Ekolo*, and for its castings *Idinkolo*; in fishing the former is used as in other parts of the world for bait, while the latter is commonly used as plaster for the walls of houses.

I have, &c.
(Signed) Alfred Moloney.

The Right Hon.
Lord Knutsford, G.C.M.G., &c.

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* Levinsen, "Om to Regnormslægter fra Ægypten." *Vidensk. Medd. natur. Foren. i Kjøbenhavn*, 1889, p. 319.

Notes on the Soil and Cultivation of Yoruba-land, with special Remarks on the Work of Earth-worms in West Africa.

After passing the fringe of forest which skirts the lagoons to the eastward of Lagos for some 50 miles inland, a vast tract of open country is reached, extending as far as the valley of the Niger and the Haussa States beyond. Much of this is so completely deforested by long years of cultivation as to bear no spontaneous vegetation but grass; some of it, in the moister lowlands, still retains strips of the original forest, which doubtless extended at one time from the densely wooded land of the Ashantis to the Niger delta; and much of it, especially along the water-partings of the numerous shallow river valleys which drain the surface of Yoruba land, is a naturally park-like or almost moorland country with a gravel subsoil, more scanty herbage, and scattered trees. The trees which cover these less fertile tracts may be said to average from 35 to 60 to the acre. They are of stunted growth and are surrounded by a shorter and more wiry grass than that which overruns the lowlands and the richer soil. They consist chiefly of oak-like Shea Butter trees (*Butyrospermum Parkii*), some thorny bushes, and a few trees of the Palmyra or Black Run palm (*Borassus flabelliformis*), of which but little use appears to be made by the natives. Where wars and slave raids have forced the people to abandon the cultivation of the better lands, and where the yearly practice of burning the grass is no longer followed, the vegetation is seen to be fast returning to its original condition; small trees begin to assert themselves among the undergrowth; young palms—such as the Bamboo palm (*Raphia vinifera*), the Oil-palm (*Elæis guineensis*, and the Palmyra palm (*Borassus flabelliformis*) first show their leaves above the tangled brake of reedy grass, and, along with them, the cotton trees, of which three sorts are seen, the Ogea-gum tree, and young plants of the gigantic Baobab (*Adansonia digitata*) push their heads up towards the light. Wherever the richer lands are deserted for long periods by the farmer a tendency is shown to revert to the forest of shallow-rooting trees which shuts off these inland farms from the coast. It is evident, therefore, that the grass lands of this part of the interior are the result of deforesting, with the exception of those which follow the gravel beds which run parallel to the coast. The first of these gravel "ridges," as they would be called in British Honduras, occurs about five miles from the lagoon side at Ito Ike, and is surrounded by the scrubby forest called in Honduras "broken ridge," which eventually passes into and is encircled by the true forest of the Ijebu country. In the fertile lands of the interior and the forest lands near the coast the soil is the same. It is rather shallow —never more than than five feet deep—full of sand and pebbles, based upon ironstone or conglomerate, or upon the softer igneous rocks, and apparently unfavourable for the growth of lofty forest trees. Even the woodland belt which skirts the coast, though poetically described by travellers as "the impenetrable forest of West Africa," cannot for a moment compare in density or in grandeur with the forests of tropical America. The only trees of unusual bulk are the cotton trees and an occasional "Iroko" tree. In other places the crests of the Oil palm (*Elæis guineensis*), notoriously a palm of short stature, are level with the roof of the forest. I should estimate the average height of the trees in the Ijebu forest at not more than from 80 feet to 100 feet, while in the rich soil of the Oslum River valley where it enters the Ijesha country the average may be from 100 feet to 120 feet. The cotton trees, of course, tower high above the rest, but even these are not equal in

size to those of the richer American soil. There is a marked absence of the dense masses of huge lianas which form so important a feature in other tropical forests, few of the trees are thorny, and one can safely plunge the hand into any part of the dense undergrowth on either side of the road. When I say that it would be possible to fell any one of the trees which compose this forest without dragging any of the rest along with it, except those in the line of its fall, it will be understood how different in its manner of growth is this so-called "impenetrable forest" from the really dense vegetation which exists in other parts of the world. It may be that, elsewhere on the West Coast, are to be found more lofty growths or denser and more tangled woods. They did not lie in our track.

The only difference between the grass lands lying beyond Ibadan towards the Niger, and the forests fringing the lagoons and covering the rugged Ijesha country, appears to be that for many generations the industrious farmers of Yoruba have, with axe and fire, destroyed the growing trees and robbed the soil of its original covering, leaving nothing but a rank growth of tall and tangled grass to take its place.

Though apparently so unfavourable to the growth of deep-rooting plants, the soil shows a truly surprising surface fertility when subjected to cultivation. A glance at the map will show how crowded is the population of this part of the interior. Not a single square mile of good soil throughout the land of Yoruba but shows traces of recent cultivation. Cut off completely from the markets of the coast by a jealous and unscrupulous tribe of idle natives who inhabit the forest strip near the Eastward Lagos lagoons, this densely peopled land is entirely dependent upon its soil for food and clothing. Well is it repaid for the labour which it expends. From samples of the soil which I forward, Nos. 1, 2, and 3, it will be seen to be composed of a sandy loam derived from the igneous rocks or ironstone and quartz conglomerates which form the bed rock. Where the harder dykes give place to the more friable micaceous rocks the soil increases in fertility, and even when farms are made on the surface of the less fertile conglomerates, in soil not more than a foot in depth, the results are truly astonishing. It may be that analysis will show the samples of soil which I have gathered to possess unusual elements of fertility, though, to the casual observer, the reverse would seem to be the case. The fact remains the same, that not only are the crops which are gathered in Yoruba, and, presumably, throughout this portion of the interior, of unusual excellence, but the surface soil shows a marvellous recuperative power, even when compared with that of more favoured lands in other portions of the tropics.

The following statement of the rotation of crops customary in Yoruba will serve to show the unusual rapidity with which this shallow and unpromising soil recovers its fertility. It has to be remembered that, during the intervals of its cultivation, short as they are, no heavy growth of bush is made as in the deeper and richer soil of tropical America, and of the West Indies. A rank growth of reedy grass, from 6 feet to 12 feet high, replaces the crowded crops; heavy rains beat down through its feeble protection upon the sandy soil, and the water rushes off in all directions into the numerous sandy brooks and rocky streams which hurry towards the lagoons with their burden of sand and mud.

Rotation of Crops.

First Year.—In the month of November the farmer scrapes a number of holes with his hoe, and plants his yams, covering them by gathering

the soil into heaps at intervals of about 18 inches. In March and April he plants, between the yam hills, Indian corn. In three months' time the corn ripens and is cropped. Early in October maize and beans are again planted between the yams and are cropped with them in December or January, or are left to stand in the field during the dry season.

During the *second year* a precisely similar course is followed with almost equally good results, while in the *third year* of cultivation the land is expected to yield two crops of maize and beans, no manure of any kind being used, nor any tool more powerful than the hoe.

For two or three years, and for no longer, the land is left to lie fallow. During this interval in its cultivation it bears a heavy crop of rank grass and scanty bushes. After this short rest it is expected to be in a condition to warrant a fresh attack, and in the months of November and December of the third year and in the first month of the fourth year of its idleness the vegetation which has sprung up is cut down, dried, and burnt on the land, and the process of planting described above begins once more. As each farmer owns but a small portion of land, the property, perhaps, of his father and grandfather before him, upon which he is wholly dependent for his livelihood, he would be left entirely without food were its fertility to become exhausted. Apparently this is never the case. For generations in succession the same crops are planted and an equal return is given by the soil.

Guinea-corn.—A guinea-corn field is planted and cropped in the first year of cultivation. The plants are then bent down about a foot and a half from the ground and allowed to shoot again from the roots. During the second year a crop not less than that given during the first year is gathered. The stalks are then cut down and burnt, and a crop of yams, or corn and beans, or cotton is raised in the third year of cultivation. After this the land is allowed to lie fallow for the usual period unless the third year's crop is unusually heavy, in which case a fourth year's crop of corn and beans is raised.

Cotton.—In cultivating cotton the Yoruba, after cleaning the land thoroughly, plants corn (maize) at the usual distances. When the maize is three feet high and thick enough to serve as a shade plant, cotton seed is sown in the intervals. When the maize ripens it is gathered, and the stalks are bent down so as to allow the cotton plants free scope for growth, while protecting their roots from the direct rays of the sun. The cotton is ready for gathering in January or February, but no second crop of maize is planted among it.

In the second year yams are planted between the cotton, and in the following year the land is cleaned, and the cotton is left to seed a third time.

Tobacco.—For tobacco planting a seed bed is made on rotten grass covered with earth, during the March rains. A moist place is chosen for the purpose. From 17 to 30 days after sowing, the seedlings are pricked out in newly cleaned land. Two crops a year are gathered for the first two years, after which the plants are removed and corn and beans are planted in the third year. With the tobacco nothing is grown, and some little care is taken to pinch off the side-shoots and heads in order to ensure a strong growth of leaves.

Indigo (*Elu*).—Indigo* is planted in any soil, and is a permanent crop. It is planted from slips at irregular intervals, and from time

* The West African indigo here described is obtained from *Lonchocarpus cyanescens*, a woody climber 20 to 30 feet long. *See* Kew Bulletin, November 1888, p. 268, with plate.

to time the surface roots are severed from the stem, pulled out of the ground to a distance of one or two yards from the parent plant, and left projecting. They rapidly develop leaves, and become, in their turn, parent trees, and in this way in five or six years a field becomes quite densely crowded.

Sweet Potatoes.—Sweet potatoes are planted and gathered, and a crop of maize is raised from the vacant land during the first year. In the second year yams are raised, together with a crop of maize at the latter end of the year. In the third year corn (maize) and beans, or yams, are grown, after which the land is allowed its usual period of inactivity.

In spite of the exhaustive system of cultivation which I have described, and which has apparently been pursued for untold generations, the crops show no signs of falling off either in size or quality. From the attached list of prices* ruling at two places over 50 miles apart, one of which, Ibadau, is a town of 150,000 inhabitants, while the other, Ikirun, is a crowded war camp where food is considered to be scarce and expensive, it will readily be seen that produce is plentiful to an extent, perhaps, unknown in any other part of the world. While buying eggs at Ikirun for 2*d.* a dozen a bystander began to lament the dearness of provisions now ruling in the town, and to regret the golden age before the war when eggs were sold for three farthings a dozen, and produce of all kinds was really cheap. Maize at 4½*d.* for a 70 lb. load can hardly be considered to command a famine price, while yams at 3*d.* a dozen, sweet potatoes at 1*d.* a 70 lb. load, beans at 1*s.* for 70 lbs., and guinea-corn at 6*d.* a load, cannot be justly lamented as involving ruin upon the purchasers.

On first realising these facts it is natural that one should look around in search of a sufficient cause for such striking results. It is not so much the fertility of the soil as shown by the abundance of any single crop which surprises one. There are many soils which give much heavier crops, and of finer quality. What is less easy of explanation is the wonderful rapidity with which it recovers from the careless cultivation and excessive cropping with such short intervals of rest to which it has for generations and perhaps for centuries been subjected.

Fresh from the lessons of Drummond's "Tropical Africa," with its most interesting chapter on the fertilising effect of the work of termites in East Africa, one naturally seeks to explain this difficulty in a similar manner. Unfortunately, ant-hills are exceptionally small and widely scattered throughout Yoruba-land. Such as there are appear to be of too hard and enduring a nature to enable the land in which they are placed to recover its fertility in so short a space of time. For mining purposes and the valuable process of bringing the subsoil to the surface, they are doubtless of great use, but their slow and feeble efforts are plainly inadequate to produce such startling results. Were one to visit Yoruba during the early part of the rainy season only, it would appear impossible to account for these facts, and one would be obliged to seek refuge in ant-hills, and to fall back upon the labour of termites in order to explain the mystery, while under our feet unnoticed was going on the ceaseless labour of the real fertilisers of the land.

In the dry season the mystery is at once solved, and in the simplest and most unexpected manner. The whole surface of the ground among the grass is seen to be covered by serried ranks of cylindrical worm casts. These worm casts vary in height from a quarter of an

* Not printed.

inch to three inches, and exist in astonishing numbers. It is, in many places, impossible to press your finger upon the ground without touching one. For scores of square miles they crowd the land, closely packed, upright, and burnt by the sun into rigid rolls of hardened clay. There they stand until the rains break them down into a fine powder, rich in plant food, and lending itself easily to the hoe of the farmer.

From the sample of these worm casts which I forward it will be seen that they are very different in form from those familiar to us in our English gardens.

On digging down the soil is found to be drilled in all directions by countless multitude of worm drills, while from 13 inches to 2 feet depth the worms are found in great numbers in the moist subsoil. It is impossible to estimate their number per cubic foot in the soil, as the quantity varies according to the season and the locality. Of the worms themselves I forward specimens preserved in spirits, which should serve to identify their species.

Having carefully removed the worm casts of one season from two separate square feet of land at a considerable distance from one another, and chosen at random, I find the result to weigh not less than $10\frac{3}{4}$ pounds in a thoroughly dry state. This gives a mean of over 5 pounds per square foot. Accepting this as the amount of earth brought to the surface every year by these worms, we get somewhat startling results. I may say, speaking from the result of numerous experiments, that 5 pounds is a very moderate yearly estimate of the work done by these busy labourers on each square foot of soil. Even at this moderate estimate, however, of the annual result of their work we have a total of not less than 62,233 tons of subsoil brought to the surface on each square mile of cultivable land in the Yoruba country every year. This work goes on unceasingly, year after year, and to the untiring labours of its earth-worms this part of West Africa owes the livelihood of its people. Where the worms do not work the Yoruba knows that it is useless to make his farm.

Estimating 1 square yard of dry earth by 2 feet deep as weighing half a ton, we have an annual movement of earth per square yard to the depth of 2 feet, amounting to not less than 45 lbs. From this it appears that every particle of earth in each ton of soil to the depth of 2 feet is brought to the surface once in 27 years.

Of the effect of this constant moving of the soil upon the health of the country it is not possible for anybody but an expert to speak, but it seems more than probable that the comparative freedom of this part of West Africa from dangerous malarial fevers is due, in part at least, to the work of earth-worms in ventilating and constantly bringing to the surface the soil in which the malarial germs live and breed. It is, perhaps, a temptation to attribute to them too many virtues, but it seems not unlikely that the beneficial effect of their labour in this direction would be very considerable.

(Signed) ALVAN MILLSON.